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TRANSLATING RESEARCH INTO ACTION

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Mass Deworming: A Best-Buy for Education and Health

Ask children around the world why they are not in school and you will get many answers: cost, distance, lack of facilities. Very few of them will mention worms—soil-transmitted helminths (STHs) and schistosomes. Until recently few experts would have mentioned worms as a key barrier to schooling either.

Four hundred million children of school-age are chronically infected with intestinal worms. Infected children suffer listlessness, diarrhea, abdominal pain and anemia. These parasites are so widespread that some societies do not recognize infection as a medical problem. Symptoms of worms, such as blood in the stool, are considered a natural part of growing up. So even though safe, cheap, and effective oral medication that can kill 99 percent of worms in the body is available and the World Health Organization (WHO) recommends mass deworming of school-aged children, only 10 percent of at-risk children get treated.

This Briefcase (based on Miguel and Kremer, 2004; and Kremer and Miguel, 2007) reports the results of a randomized impact evaluation of a deworming program in western Kenya. The results show that school-based mass deworming—where every child in a school is treated—is the most cost-effective way to increase school participation (of all the alternatives that have been rigorously evaluated). It is also one of the most cost-effective ways to improve health that we know of.

Similar educational benefits were found when intestinal worms were eradicated from the southern states of the U.S. in 1915 (Bleakley, 2007). Follow-up work found that attempts to make the program self-sustaining—through health education and user fees—led to its collapse. Only long-term funding of a school-based program sustained the benefits.

For more details on this study see Miguel and Kremer (2004) and Kremer and Miguel (2007) available at www.povertyactionlab.org

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Summary	
What was done	About 30,000 children in 75 primary schools in rural Kenya were treated *en masse* in schools with drugs for hookworm, whipworm, roundworm, and schistosomiasis (bilharzia).
Key Impacts	Reduced the incidence of moderate-to-heavy infections by 25 percentage points.
	Reduced school absenteeism by 25 percent, with the largest gains among the youngest pupils.
	School participation in the area increased by at least 0.14 years of schooling per treated child.
	There was no evidence that deworming increased test scores.
Cost Effectiveness	Cost: 50 cents per child per year
	Health: US$5 for every Disability Adjusted Life Year (DALY) saved
	Education: US$3.50 for each additional year of school participation

The Primary School Deworming Program in Kenya

The Primary School Deworming Program was implemented by International Child Support, Africa (ICS) in a poor and densely-settled farming district in western Kenya with high worm infection rates. Altogether, 75 primary schools with a total enrolment of 30,000 pupils aged between 6 and 18 years participated in the program.

Due to administrative and financial constraints, ICS randomly phased the program into schools over several years, providing the opportunity to rigorously evaluate program impact. Other studies had randomized at the individual level (within schools). But, since the control group also benefited, being less likely to catch worms from their neighbors, these studies underestimated the impact of deworming. Because entire schools were randomized into treatment in this case, the study gave a more accurate measure of program impact. Miguel and Kremer went further and measured the magnitude and reach of the spillovers—how much neighboring schools benefited and how far, geographically, these benefits extended. They did this by comparing outcomes in control schools that were near treatment schools with control schools that were not near treatment schools.

Treatment followed WHO recommendations (see Box 1). The drugs were administered by public health nurses from the Ministry of Health in the presence of health officers from ICS.

1. Deworming improved health for treated children and their neighbors

Mass deworming improved the health of treated children and their neighbors. Infection rates fell for children who got the treatment and those in the treatment schools who did not get treated—in other words, there were within-school spillovers. Moderate-to-heavy infection rates also fell for children attending control schools that were close to treatment schools (compared to control schools that were far from treatment schools), suggesting the spillovers were experienced for several kilometers.

Spillovers for soil-transmitted helminths (STHs) treatment were primarily within schools, while spillovers for schistosomiasis treatment were primarily across schools. The proportion of pupils with moderate-to-heavy infections was 25 percentage points lower in treatment schools than in control schools in 1999, the second year of the program. On average, moderate-to-heavy infections were 23 percentage points lower in the area as a result of the program.

2. Deworming reduced school absenteeism by at least a quarter, with large participation gains among the youngest children

Deworming increased school participation in treatment schools by at least 7 percentage points, a 25 percent reduction in total school absenteeism. Including spillovers, school participation in the area increased by at least 0.14 years of schooling per child treated. Participation gains were especially large among the youngest pupils.

The results have been supported by other evidence. A randomized study in India showed that addressing anemia (a symptom of worm infection) had important impacts on schooling and health (Bobonis et al, 2006) while a non-randomized study of intestinal worm eradication in the south of the U.S. found similar schooling benefits as well as later gains in wages (Bleakley, 2007).

BOX 1: **Worms and deworming—some facts**

Intestinal worms and schistosome infections account for over 40 percent of the worldwide burden of all tropical diseases, excluding malaria (WHO, 1999a) with over 2 billion people affected and 300 million suffering severe morbidity (Crompton, 1999). Worm infections are common throughout most of sub-Saharan Africa, much of South East Asia, indigenous populations in rural Latin America, and peri-urban slum dwellers. In particular schistosome infections are concentrated around lakes and other sources of freshwater.

The worms that most commonly infect children are the soil transmitted helminths (STH)—hookworms, roundworms, whipworms—and schistosomes. They are transmitted by eggs excreted in human feces or urine, which contaminate the soil or water sources in areas with poor sanitation. Humans are infected when they ingest eggs or larvae on contaminated food or hands (hookworm, whipworm, and roundworm), and when their skin is penetrated by infective larvae in contaminated soil (hookworms) or fresh water (schistosomes). Worms live in the intestines and the urinary tract and do not multiply in the body. Their numbers build up through repeated infection, via repeated contact with contaminated soil or water.

Albendazole or mebendazole are used to treat STH infections and praziquantel to treat schistosomiasis. These drugs are cheap and safe. One treatment for STH infections costs less than 3 US cents while one treatment for schistosomiasis costs less than 20 US cents (World Bank, 2003). The WHO has endorsed school-based mass deworming in areas with high prevalence (WHO, 2004).

A Partnership for Evaluating the Impacts of Mass Deworming

The evaluation was a collaboration between International Child Support (ICS) Africa, the Kenyan Ministry of Education, Science and Technology, the Kenyan Ministry of Health, Partnership for Child Development, Edward Miguel, Professor of Economics at the University of California, Berkeley, and Michael Kremer, Gates Professor of Developing Societies at Harvard University. Edward Miguel and Michael Kremer are both members of the Adbul Latif Jameel Poverty Action Lab at Massachusetts Institute of Technology.

3. Test scores did not improve

Deworming could improve test scores by increasing time spent in school or by increasing the ability of children to concentrate and learn when in class. However, there is no evidence that deworming increased test scores despite the increase in attendance.

4. Long-term effects on health and education

A follow-up study is estimating the short to medium-run impacts on health and education. Preliminarily results suggest that deworming may have caused children to grow taller and heavier, and therefore healthier, in treatment than in control schools.

5. Cost effectiveness

The cost effectiveness of health projects is measured using a standard yardstick of cost per Disability Adjusted Life Year (DALY) saved. The direct and spillover effects of the deworming program added up to 649 DALYs from the first wave of the program. Estimated costs of implementing a similar deworming program are US$0.50 per pupil per year. This translates to a cost of about US$5 per DALY saved. (For comparison, the measles and diphtheria, pertussis, and tetanus vaccinations cost 12 to 17 US dollars per DALY saved).

Most of the health gains are due to reductions in moderate-to-heavy schistosomiasis infections. Spillover benefits account for 76 percent of the overall DALY reduction.

The cost per additional year of school participation, including spillovers, was estimated to be only US$3.50 in 1998 (note that revised figures to be issued shortly suggest an even lower cost per year of schooling induced). This makes deworming by far the most cost-effective method for improving school participation when compared to other educational programs implemented in the same region and elsewhere (J-PAL, 2005).

BOX 2: **Long-term funding: the only sustainable solution**

ICS looked at alternative ways to scale the program and make it self-sustaining. The first was to explain to children and parents the implications of getting worms and strategies to prevent infection (such as hand washing and wearing shoes). In this way, worm loads could be decreased without resort to medication. The second strategy was to teach children and parents the benefits of deworming and encourage them to pay the modest cost of the medication themselves.

Health education led to no changes in behavior and user fees (introduced to a random sample of communities) led to the collapse of the program.

The only communities that sustained the gains of deworming were those randomly chosen to receive continued funding for free mass school-based deworming. The fact that many of the benefits of taking the drugs spills over to others in the community provides a strong economic rationale for subsidizing deworming programs and without this funding from NGOs or government, the gains are not sustainable (Kremer and Miguel, 2007).

POLICY LESSONS:

Funding mass, school-based deworming programs in areas of high worm load is among the most cost effective things any government, agency, or donor can do with their money. It is simultaneously one of the most cost-effective ways to improve child health and the most cost-effective way to increase school attendance. School-based mass deworming does involve getting health and education personnel to work together, but the rewards are large.

The study also demonstrates that asking people what barriers they face may not necessarily be a reliable way of finding out their problems. In this case, deworming may be the best way to increase attendance at school but it is unlikely to be high on the list of issues children themselves (or their parents) raise.

On a more methodological issue, the study shows the importance of considering and carefully measuring the benefits a program may have on those who are not the intended beneficiaries. The methodology for doing the analysis in this paper has since been used in other studies and helped win the authors the 2005 Kenneth J. Arrow Award for Best Paper in Health Economics given by the International Health Economics Association.

Finally, this study raises important questions about how we think about making programs sustainable. Because children become reinfected quickly, they often need to be treated every 6 months. Explaining the benefits of prevention and treatment did not by themselves change behavior or make children or parents willing to pay for the drugs. This might be a rational response given that many of the benefits accrue to others. When deciding what programs to fund, instead of asking “can this program become self-sustaining” a better test may be “is this program worth sustaining”—do the overall benefits outweigh the costs? In the case of deworming, the answer in areas of high worm load is a resounding “Yes!”

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The Abdul Latif Jameel Poverty Action Lab (J-PAL) at the MIT Department of Economics is dedicated to fighting poverty by ensuring that policy decisions are based on scientific evidence. We achieve this objective by undertaking, promoting the use of, and disseminating the results of randomized evaluations of poverty programs. If you would like to be added to our mailing list, please contact us at povertyactionlab@mit.edu.

References:

Bleakley, Hoyt (2007), "Disease and Development: Evidence from Hookworm Eradication in the American South," *Quarterly Journal of Economics* 122 (1): 73-117.

Bobonis, Gustavo, Edward Miguel, and Charu Puri Sharma (2006), "Iron Deficiency Anemia and School Participation," *Journal of Human Resources* 41(4): 692-721.

Chaudhury, Nazmul, Jeffrey Hammer, Michael Kremer, Karthik Muralidharan, and F. Halsey Rogers (2006), "Missing in Action: Teacher and Health Worker Absence in Developing Countries," *Journal of Economic Perspectives* 20(1): 91-116.

Crompton, D.W.T. (1999), "How Much Helminthiasis Is There in the World?" *Journal of Parasitology* 85: 397 – 403.

Kremer, Michael and Edward Miguel (2007), "The Illusion of Sustainability," *Quarterly Journal of Economics* 122(3), August 2007.

Miguel, Edward, and Michael Kremer (2004), "Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities," *Econometrica* 72(1): 159-217.

World Bank (2003), "School Deworming at a Glance," *Public Health at a Glance Series*. http://www.worldbank.org/hnp.

WHO (1999), "The World Health Report 1999," World Health Organization, Geneva.

WHO (2004), "Action Against Worms" Partners for Parasite Control Newsletter, Issue #1, January 2004 (available at www.who.int/wormcontrol/en/action_against_worms.pdf)

J-PAL (2005), "Education: Meeting the Millennium Development Goals" /Fighting Poverty: What Works?/ Issue 1.

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